

**SYNTHESIS OF Au-CERIUM OXIDE FOR CATALYTIC
REDUCTION OF PARA-NITROPHENOL**

NUR SAKEENAH BINTI KHAIRUDIN

**BACHELOR OF SCIENCE (Hons.) CHEMISTRY WITH
MANAGEMENT
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA**

AUGUST 2023

This Final Year Project entitled “**Synthesis of Au-Cerium Oxide for Catalytic Reduction of *para*-Nitrophenol**” was submitted by Nur Sakeenah binti Khairudin in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Chemistry with Management, in the Faculty of Applied Sciences, and was approved by

Hanani binti Yazid
Supervisor
B. Sc. (Hons.) Chemistry with
Management
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

Dr. Siti Nurlia binti Ali
Project Coordinator
B. Sc. (Hons) Applied
Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

Dr. Nur Nasulhah binti Kasim
Head of Programme
B. Sc. (Hons.) Applied
Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

ABSTRACT

SYNTHESIS OF Au-CERIUM OXIDE FOR CATALYTIC REDUCTION OF PARA-NITROPHENOL

The reduction of *p*-nitrophenol is a widely studied reaction and serves as an important model reaction to evaluate the catalytic activity. In this study, a facile and scalable synthesis method was employed to prepare cerium oxide support via chemical and co-precipitation, meanwhile gold (Au) was deposited on cerium oxide support via deposition-precipitation (DP) method through a controlled reduction process is presented in this thesis. The cerium oxide support was synthesized with cerium nitrate as the precursor mixed with ammonia solution and potassium carbohydrate via chemical and co-precipitation technique respectively. Furthermore, the resulting particles were characterized using FTIR showed a pure CeO₂ without impurities was produced and ICP-OES spectroscopy showed the composition of Au loading in catalyst with value 0.565 and 0.349 mg/L for chemical and co-precipitation respectively. Moreover, the characterization of Au/CeO₂ catalyst by FTIR confirmed the immobilization of Au on CeO₂ support due to band shifting. The catalytic activity of *p*-nitrophenol reduction achieved 100% conversion to *p*-aminophenol for chemical and co-precipitation method with the rate constant (*k*) of 3.0383x10⁻³ and 5.103x10⁻³ s⁻¹ respectively. The reaction kinetics were monitored using UV-visible spectroscopy. The successful reusability test for both Au/CeO₂ catalysts proved that catalysts can be use again for several times.

TABLE OF CONTENTS

ABSTRACT	iii
ABSTRAK	iv
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vi
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF SYMBOLS	x
LIST OF ABBREVIATIONS	xi
	1
CHAPTER 1 INTRODUCTION	
1.1 Background of Study	1
1.2 Problem Statement	3
1.3 Significance of Study	4
1.4 Objectives of Study	4
	5
CHAPTER 2 LITERATURE REVIEW	
2.1 Cerium Oxide, CeO ₂	
2.2 Preparation method of CeO ₂	6
2.2.1 Co-precipitation	
2.2.2 Chemical precipitation	7
2.3 CeO ₂ nanoparticles' application	8
2.3.1 UV protection	
2.3.2 Solid oxide fuel cells	
2.4 Supported catalyst	
2.5 Nanoparticles	9
2.5.1 Gold nanoparticles	
2.5.2 Au/CeO ₂ via deposition-precipitation method	10
2.5.3 Catalytic reduction of <i>p</i> -Nitrophenol	11
CHAPTER 3 METHODOLOGY	12
3.1 Materials	
3.1.1 Co-precipitation	
3.1.2 Chemical precipitation	
3.2 Method	13

3.2.1 Preparation of support: CeO ₂	
3.2.2 Preparation of gold nanoparticles supported on CeO ₂	14
3.3 Characterization	15
3.3.1 FTIR spectroscopy	
3.3.2 ICP-OES	
3.3.3 UV-Vis spectrophotometry	16
3.4 Experimental design/flow chart	17
CHAPTER 4 RESULTS AND DISCUSSION	22
4.1 CeO ₂ particle	
4.2 Au-CeO ₂ catalyst	24
4.3 Catalytic activity of p-NP over Au/CeO ₂	26
4.3.1 Reusability	29
CHAPTER 5 CONCLUSION AND RECOMMENDATIONS	32
5.1 Conclusion	
5.2 Recommendations	33
CITED REFERENCES	34
APPENDICES	37
CURRICULUM VITAE	41